IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

FOREST LABORATORIES, INC., FOREST LABORATORIES HOLDINGS, LTD., MERZ PHARMA GMBH & CO. KGAA, and MERZ PHARMACEUTICALS GMBH,	)	
Plaintiffs,	)	C.A. No. _____
v.	)	
ORGENUS PHARMA INC.,	)	
Defendants.	)	

COMPLAINT

Plaintiffs Forest Laboratories, Inc., Forest Laboratories Holdings, Ltd., Merz Pharma GmbH & Co. KGaA, and Merz Pharmaceuticals GmbH (collectively, "Plaintiffs") for their Complaint against Defendant Orgenus Pharma Inc. hereby allege as follows:

PARTIES

1. Plaintiff Forest Laboratories, Inc. ("Forest Labs") is a Delaware corporation having a principal place of business at 909 Third Avenue, New York, New York 10022.

2. Plaintiff Forest Laboratories Holdings, Ltd. is an Irish corporation having a principal place of business at Milner House, 18 Parliament Street, Hamilton JM11, Bermuda (collectively, with Forest Labs, "Forest").

3. Plaintiff Merz Pharma GmbH & Co. KGaA is a German corporation having a principal place of business at Eckenheimer Landstraße 100, D-60318 Frankfurt am Main, Germany.

4. Plaintiff Merz Pharmaceuticals GmbH is a German corporation having a principal place of business at Eckenheimer Landstraße 100, D-60318 Frankfurt am Main, Germany (collectively, with Merz Pharma GmbH & Co. KGaA, "Merz").

5. Upon information and belief, Defendant Orgenus Pharma Inc. ("Orgenus") is a New Jersey corporation having a principal place of business at 700 Alexander Park, Suite 104, Princeton, New Jersey 08540. Upon information and belief, Defendant Orgenus is the subsidiary of Orchid Pharmaceuticals Inc. ("Orchid Pharma"), a Delaware corporation having a principal place of business at 2711 Centerville Road, Suite 400, Wilmington, Delaware 19808.

6. Upon information and belief, Defendant Orgenus manufactures and/or distributes numerous generic drugs for sale and use throughout the United States, including in this judicial district.

NATURE OF THE ACTION

7. This is a civil action for infringement of United States Patent No. 5,061,703 ("the '703 patent") (Exhibit A). This action is based upon the Patent Laws of the United States, 35 U.S.C. § 100 *et seq*.

JURISDICTION AND VENUE

8. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

9. This Court has personal jurisdiction over Defendant Orgenus by virtue of the fact that, *inter alia*, Orgenus has committed, or aided, abetted, contributed to and/or participated in the commission of the tortious act of patent infringement that has led to foreseeable harm and injury to Plaintiffs, including Plaintiff Forest Labs, a Delaware corporation. This Court has personal jurisdiction over Defendant Orgenus for the additional

reasons set forth below and for other reasons that will be presented to the Court if such jurisdiction is challenged.

10. This Court has personal jurisdiction over Defendant Orgenus by virtue of, *inter alia*: (1) its presence in Delaware through its parent Orchid Pharma; and (2) its systematic and continuous contacts with Delaware, including through its parent Orchid Pharma.

11. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391 and 1400(b).

THE PATENT-IN-SUIT

12. On October 29, 1991, the '703 patent, titled "Adamantane Derivatives in the Prevention and Treatment of Cerebral Ischemia," was duly and legally issued by the United States Patent and Trademark Office ("PTO"). Merz has been, and continues to be, the sole assignee of the '703 patent since its issuance.

13. Forest is the exclusive licensee of the '703 patent in the United States. Forest holds New Drug Application ("NDA") No. 21-487 for Namenda® brand memantine hydrochloride tablets. The '703 patent is listed in the *Approved Drug Products with Therapeutic Equivalence Evaluations* ("Orange Book") for NAMENDA®.

14. Forest is the exclusive distributor of NAMENDA® in the United States.

15. On August 18, 2004, Merz submitted a request to the PTO for reexamination of the '703 patent. The PTO issued a reexamination certificate (Exhibit B) for the '703 patent on November 7, 2006.

ACTS GIVING RISE TO THIS ACTION

Infringement Of The '703 Patent By Defendant Orgenus

16. Upon information and belief, Defendant Orgenus, as the agent and on behalf of its parents Orchid Pharma and Orchid Chemicals & Pharmaceuticals Ltd.

(d/b/a Orchid Healthcare) ("Orchid India") (collectively with Orchid Pharma, "Orchid"), submitted Abbreviated New Drug Application ("ANDA") No. 90-044 to the FDA under § 505(j) of the Federal Food, Drug and Cosmetic Act (21 U.S.C. § 355(j)). That ANDA seeks FDA approval for the commercial manufacture, use and sale of generic tablet products containing 5 milligrams and 10 milligrams of memantine hydrochloride ("the Orchid Generic Products"). ANDA No. 90-044 specifically seeks FDA approval to market the Orchid Generic Products prior to the expiration of the '703 patent.

17. Pursuant to § 505(j)(2)(A)(vii)(IV) of the Federal Food, Drug and Cosmetic Act, Orgenus alleged in ANDA No. 90-044 that the claims of the '703 patent are invalid, unenforceable and/or not infringed by the commercial manufacture, use or sale of the Orchid Generic Products. Plaintiffs received written notification of ANDA No. 90-044 and its § 505(j)(2)(A)(vii)(IV) allegations from Orchid India on or about December 11, 2007.

18. Orchid India's written notification to Plaintiffs failed to identify Orgenus as the U.S. regulatory agent who filed the ANDA on Orchid's behalf. Orgenus was not identified to Plaintiffs as Orchid's U.S. regulatory agent until March 3, 2008, when Orchid India filed a motion to dismiss for lack of personal jurisdiction in a related case that is presently pending before this Court, *Forest Labs., Inc. v. Cobalt Labs., Inc.*, Civil Action No. 08-021-GMS-LPS (D. Del. 2008).

19. Orchid's India's failure to identify Orgenus as its U.S. regulatory agent fails to satisfy the requirements of at least 21 C.F.R. § 314.95(c)(7).

20. Orgenus's submission of ANDA No. 90-044 to the FDA, as the agent and on behalf of its parents Orchid Pharma and Orchid India, including its § 505(j)(2)(A)(vii)(IV) allegations, constitutes infringement of the '703 patent under 35 U.S.C. § 271(e)(2)(A).

Moreover, if Orgenus commercially manufactures, uses, offers to sell, sells, or imports any of the Orchid Generic Products, or induces or contributes to any such conduct, it would further infringe the '703 patent under 35 U.S.C. § 271(a), (b) and/or (c).

21. Orgenus was aware of the '703 patent prior to filing ANDA No. 90-044.

22. Orgenus's actions render this an exceptional case under 35 U.S.C. § 285.

23. Plaintiffs will be irreparably harmed by Orgenus's infringing activities unless those activities are enjoined by this Court. Plaintiffs do not have an adequate remedy at law.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs pray for judgment as follows:

A. That Defendant Orgenus has infringed the '703 patent;

B. That, pursuant to 35 U.S.C. § 271(e)(4)(A), the effective date of any approval of Orgenus' ANDA identified in this Complaint shall not be earlier than the expiration date of the '703 patent, including any extensions;

C. That Orgenus, its officers, agents, servants and employees, and those persons in active concert or participation with any of them, be preliminarily and permanently enjoined from commercially manufacturing, using, offering for sale, selling, or importing any of the proposed generic versions of Plaintiffs' NAMENDA® brand product identified in this Complaint and any other product that infringes or induces or contributes to the infringement of the '703 patent, prior to the expiration of the '703 patent, including any extensions;

D. That this case is exceptional under 35 U.S.C. § 285;

E. That Plaintiffs be awarded the attorney fees, costs and expenses that they incur prosecuting this action; and

F. That Plaintiffs be awarded such other and further relief as this Court deems just and proper.

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May 16, 2008

EXHIBIT A

United States Patent [19]

Bormann et al.

[11] Patent Number: 5,061,703

[45] Date of Patent: Oct. 29, 1991

[54] ADAMANTANE DERIVATIVES IN THE PREVENTION AND TREATMENT OF CEREBRAL ISCHEMIA

[75] Inventors: Joachim Bormann, Frankfurt; Markus R. Gold, Nauheim; Wolfgang Schatton, Eschborn, all of Fed. Rep. of Germany

[73] Assignee: Merz + Co. GmbH & Co., Frankfurt am Main, Fed. Rep. of Germany

[21] Appl. No.: 508,109

[22] Filed: Apr. 11, 1990

[30] Foreign Application Priority Data

Apr. 14, 1989 [EP] European Pat. Off. 89106657

[51] Int. Cl.[5] A61K 31/13; A61K 31/41; A61K 31/55; A61K 31/445

[52] U.S. Cl. 514/212; 514/325; 514/359; 514/662

[58] Field of Search 514/212, 325, 359, 662

[56] References Cited

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0227410 7/1987 European Pat. Off. .

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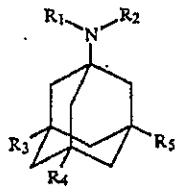
Primary Examiner—Stanley J. Friedman

Attorney, Agent, or Firm—Gordon W. Hueschen

[57] ABSTRACT

A method for the prevention and treatment of cerebral ischemia using an adamantane derivative of the formula



(I)

wherein

R_1 and R_2 are identical or different, representing hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

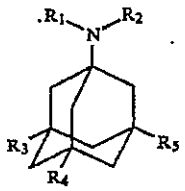
R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group,

or a pharmaceutically-acceptable salt thereof, is disclosed.

13 Claims, No Drawings

ADAMANTANE DERIVATIVES IN THE PREVENTION AND TREATMENT OF CEREBRAL ISCHEMIA

The present invention relates to a method for the prevention or treatment of cerebral ischemia using an adamantane derivative of the following general formula



(I)

wherein

R_1 and R_2 are identical or different and represent hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic radical with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl; and

wherein

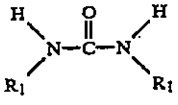
R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group, or a pharmaceutically-acceptable acid addition salt thereof. Herein branched or straight C_1–C_6 alkyl groups representatively include methyl, ethyl, iso- and n-propyl, n-, iso- and t-butyl, n-pentyl, n-hexyl, and the isomers thereof.

Certain 1-amino adamantanes of formula (I) are known. 1-amino-3,5-dimethyl adamantane, for example, is the subject matter of German patents 22 19 256 and 28 56 393.

Some 3,5-disubstituted 1-amino adamantanes of formula (I) are described in U.S. Pat. No. 4,122,193. 1-amino-3-ethyl adamantane is described in German Patent 22 32 735.

The compounds of formula (I) are generally prepared by alkylation of halogenated adamantanes, preferably bromo- or chloroadamantanes. The di- or tri-substituted adamantanes are obtained by additional halogenation and alkylation procedures. The amino group is introduced either by oxidation with chromiumtrioxide and bromination with HBr or bromination with bromine and reaction with formamide followed by hydrolysis. The amino function can be alkylated according to generally-accepted methods. Methylation can, for example, be effected by reaction with chloromethyl formate and subsequent reduction. The ethyl group can be introduced by reduction of the respective acetamide.

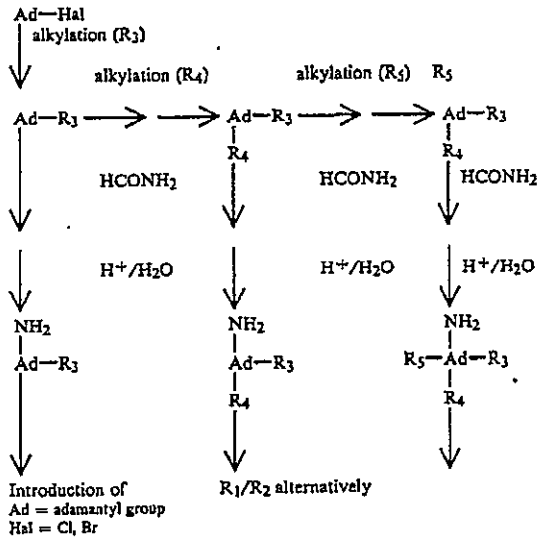
In accordance with U.S. Pat. No. 4,122,193 amination can also be effected by reaction of the respective 1-halogen-3,5- or -7-substituted adamantane with a urea derivative of the formula



wherein R_1 is hydrogen or alkyl.

The compounds according to formula (I) are prepared according to the following reaction scheme:

Reaction scheme



Alkylation of the halogenated adamantanes can be achieved by known methods, for example, through Friedel-Crafts reaction (introduction of phenyl group), or by reaction with vinylidene chloride, subsequent reduction and suitable Wittig reaction of the aldehydes and subsequent hydration, or by introduction of ethylene and subsequent alkylation with appropriate cuprates, or by introduction of ethylene and reduction of the halogen alkyl adamantanes, or by acylation with CO_2 and reduction of the carboxylic acid.

The compounds according to formula (I) known from the above-cited patents have so far been used for the treatment of parkinsonian and parkinsonoid diseases. Their mode of action is attributed to a dopaminergic influence on the CNS, either by an increased release of the transmitter substance dopamine or by an inhibition of its uptake. This compensates the imbalance of the dopamine/acetylcholine system.

In contrast to this type of disease, cerebral ischemia is characterized by a pathophysiological situation defined by an imbalance of neuronal stimulation mechanisms. In this context, the excessive inflow of calcium through NMDA receptor channels finally leads to the destruction of brain cells in specific brain areas (Rothmann & Olney, Trends Neurosci 10, 1989, pp. 299).

Therefore, in order to treat or eliminate this pathological situation, an antagonistic intervention is required with regard to the NMDA receptor channels (Kemp et al., Trends Pharmacol., Sci. 8, 1987. pp. 414).

Such intervention can, for example, be effected using substituted fluoro and hydroxy derivatives of dibenzo-[a,d]-cyclo-heptene-5,10-imine which are described in EP-A 0 264 183.

These heterocyclic, aromatic compounds are lipophilic and exhibit NMDA receptor channel-antagonistic and anticonvulsive properties. They are prepared by a relatively expensive method generating enantiomer mixtures which may be split into the individual optical antipodes.

The present invention is aimed at preparing and employing compounds which can be chemically generated

by simple methods, exhibiting an NMDA receptor channel-antagonistic and anticonvulsive action, for use in the prevention and treatment of cerebral ischemia.

This objective can be achieved according to the invention by using the 1-amino adamantanes of formula (I).

It has been found unexpectedly that the use of these compounds prevents an impairment or further impairment, i.e., degeneration and loss of nerve cells, after ischemia. Therefore, the adamantane derivatives of formula (I) are especially suited for the prevention and treatment of cerebral ischemia after apoplexy, open-heart surgery, cardiac standstill, subarachnoidal hemorrhage, transient cerebro-ischemic attacks, perinatal asphyxia, anoxia, hypoglycemia, apnoea and Alzheimer's disease. The amount employed is a cerebral ischemia-alleviating or preventive amount.

Examples of compounds prepared and used according to the invention are:

1-amino adamantane
1-amino-3-phenyl adamantane
1-amino-methyl-adamantane
1-amino-3,5-dimethyl adamantane (test compound no. 1)
1-amino-3-ethyl adamantane (test compound no. 2)
1-amino-3-isopropyl adamantane (test compound no. 3)
1-amino-3-n-butyl adamantane
1-amino-3,5-diethyl adamantane (test compound no. 4)
1-amino-3,5-diisopropyl adamantane
1-amino-3,5-di-n-butyl adamantane
1-amino-3-methyl-5-ethyl adamantane
1-N-methylamino-3,5-dimethyl adamantane (test compound no. 5)
1-N-ethylamino-3,5-dimethyl adamantane (test compound no. 6)
1-N-isopropyl-amino-3,5-dimethyl adamantane
1-N,N-dimethyl-amino-3,5-dimethyl adamantane
1-N-methyl-N-isopropyl-amino-3-methyl-5-ethyl adamantane
1-amino-3-butyl-5-phenyl adamantane
1-amino-3-pentyl adamantane
1-amino-3,5-dipentyl adamantane
1-amino-3-pentyl-5-hexyl adamantane
1-amino-3-pentyl-5-cyclohexyl adamantane
1-amino-3-pentyl-5-phenyl adamantane
1-amino-3-hexyl adamantane
1-amino-3,5-dihexyl adamantane
1-amino-3-hexyl-5-cyclohexyl adamantane
1-amino-3-hexyl-5-phenyl adamantane
1-amino-3-cyclohexyl adamantane (test compound no. 7)
1-amino-3,5-dicyclohexyl adamantane
1-amino-3-cyclohexyl-5-phenyl adamantane
1-amino-3,5-diphenyl adamantane
1-amino-3,5,7-trimethyl adamantane
1-amino-3,5-dimethyl-7-ethyl adamantane (test compound no. 8)
1-amino-3,5-diethyl-7-methyl adamantane
1-N-pyrrolidino and 1-N-piperidine derivatives,
1-amino-3-methyl-5-propyl adamantane
1-amino-3-methyl-5-butyl adamantane
1-amino-3-methyl-5-pentyl adamantane
1-amino-3-methyl-5-hexyl adamantane
1-amino-3-methyl-5-cyclohexyl adamantane
1-amino-3-methyl-5-phenyl adamantane
1-amino-3-ethyl-5-propyl adamantane
1-amino-3-ethyl-5-butyl adamantane
1-amino-3-ethyl-5-pentyl adamantane
1-amino-3-ethyl-5-hexyl adamantane
1-amino-3-ethyl-5-cyclohexyl adamantane
1-amino-3-ethyl-5-phenyl adamantane
1-amino-3-propyl-5-butyl adamantane
1-amino-3-propyl-5-pentyl adamantane
1-amino-3-propyl-5-hexyl adamantane
1-amino-3-propyl-5-cyclohexyl adamantane
1-amino-3-propyl-5-phenyl adamantane
1-amino-3-butyl-5-pentyl adamantane
1-amino-3-butyl-5-hexyl adamantane
1-amino-3-butyl-5-cyclohexyl adamantane

their N-methyl, N,N-dimethyl, N-ethyl, N-propyl derivatives and their acid addition compounds.

Preferred compounds of formula (I) are those wherein R_1 and R_2 are hydrogen such as, for example, 1-amino-3-ethyl-5,7-dimethyl adamantane, and compounds wherein R_1, R_2, R_4 and R_5 are hydrogen such as, for example, 1-amino-3-cyclohexyl adamantane and 1-amino-3-ethyl adamantane.

Additional preferred compounds are those wherein R_1, R_2 and R_5 are hydrogen such as, for example, 1-amino-3-methyl-5-propyl or 5-butyl adamantane, 1-amino-3-methyl-5-hexyl or cyclohexyl adamantane, or 1-amino-3-methyl-5-phenyl adamantane.

Especially preferred compounds are 1-amino-3,5-dimethyl adamantane, 1-amino-3,5-diethyl adamantane, i.e., compounds wherein R_1, R_2 and R_5 are hydrogen, and compounds wherein R_1 and R_5 are hydrogen, R_2 is methyl or ethyl, and R_3 and R_4 are methyl such as, for example, 1-N-methylamino-3,5-dimethyl adamantane and 1-N-ethylamino-3,5-dimethyl adamantane.

The adamantane derivatives of formula (I) may be applied as such or in the form of their pharmaceutically-acceptable acid addition salts including, for example, the hydrochlorides, hydrobromides, sulfates, acetates, succinates or tartrates, or their acid addition salts with fumaric, maleic, citric, or phosphoric acids.

The compounds of formula (I) are administered in suitable form in doses ranging from about 0.01 to 100 mg/kg. Appropriate presentation forms are, for example, combinations of the active substance with common pharmaceutical carriers and adjuvants in the form of tablets, coated tablets, and sterile solutions or suspensions for injection. Pharmaceutically-acceptable carriers are, for example, lactose, sucrose, sorbitol, talc, stearic acid, magnesium stearate, gum arabic, corn starch, or cellulose, combined with diluents such as water, polyethylene glycol, etc. Solid presentation forms are prepared according to common methods and may contain up to 50 mg of the active ingredient per unit.

The efficacy of the compounds of formula (I) is described in the following pharmacological tests.

A. Displacement of TCP Binding

Phencyclidine (PCP), a known NMDA antagonist, binds to the NMDA receptor-associated ionic channel and blocks ionic transport (Garthwaite & Garthwaite, Neurosci. Lett. 83, 1987, 241–246). Additionally, PCP has been shown to prevent the destruction of brain cells after cerebral ischemia in rats (Sauer et al., Neurosci. Lett. 91, 1988, 327–332).

The interaction between compounds of formula (I) and the PCP bond is studied in the following. In this test ^{3}H-TCP, a PCP analogue, is used.

A membrane preparation of rat cortex is incubated with ^{3}H-TCP which is an analogue of phencyclidine (PCP) (Quirion & Pert 1982, Eur. J. Pharmacol. 83:155).

The interaction with the TCP binding is assessed for test compound no. 1 (1-amino-3,5-dimethyl adamantane) in a competitive experiment. This test shows that compound no. 1 is very effective in displacing TCP from the bond. The IC_{50} value is 89 nM. The conclusion can be drawn that compound no. 1 binds to NMDA receptor channels at the same site as the NMDA antagonist PCP.

B. Blocking of NMDA Receptor Channels

In the following test it is shown that the compounds of formula (I) according to the invention are as effective as PCP in blocking the NMDA receptor channel.

In the patch-clamp experiment, the current flowing through NMDA-activated membrane channels of cultivated spinal marrow neurons (mouse) is measured (Hamill et al 1981, Pflügers Arch. 312: 85–100). After application of 20 μM NMDA, the current signal of the cell is integrated for 20 sec. and recorded as a control answer (A_c). During succeeding application of 20 μM NMDA and 6 μM of an adamantane derivative, the intensity of the substance effect can be determined as a relative change of the control answer ($A/A_c - A$ = test answer).

The results are summarized in the following Table 1:

TABLE 1

Compound no.	1-A/Ac	n
1	0.66 ± 0.05	14
2	0.44 ± 0.08	7
3	0.58 ± 0.07	7
4	0.50 ± 0.11	5
5	0.56 ± 0.07	7
6	0.38 ± 0.05	7
7	0.25 ± 0.04	11
8	0.50 ± 0.03	6
PCP	0.50 ± 0.04	7
MK-801	0.60 ± 0.05	22

The values are given as means ± SEM.

As can be seen from the results, the aminoadamantane derivatives of formula (I) are able to block the NMDA receptor channel as has been described for PCP (Bertolini et al., Neurosci. Lett. 84, 1988, 351–355) and for 5-methyl-10,11-dihydro-5H-dibenzo[a,d]cycloheptene-5,10-imine (MK-801) (EP-A 0 264 183).

C. Anticonvulsive Effect

4, 12, 36, 108 and 324 mg/kg of the test substance is administered to mice by the intraperitoneal route (5 animals per dose). The supermaximum electroshock test is applied forty (40) minutes after application of the substance to investigate the anti-convulsive potential of the substance. The protected animals are added up over all dosages (score; maximum=25 animals).

The results are given in the following Table 2.

TABLE 2

Compound no.	Anticonvulsive action (score)	Mean	ED_{50} (mg/kg)
1	18		
	16		
	16		
	15	16.3	16
2	15		
	14		
	12	13.7	30
4	16		
	16		
	11	14.3	24
5	17		
	17	17.0	13
Standards:			
PCP	19	19.0	9
MK-801	25	25.0	<1

The ED_{50} values were estimated according to Litchfield, J. T. and Wilcoxon, F., J. Pharmacol. Exp. Therap. 96, 99–113 (1949).

As can be seen from the above results, aminoadamantane derivatives of formula (I) exhibit a protective effect against electrically induced convulsions. They therefore have an anticonvulsive effect.

D. Correlation Between Channel-Blocking and Anticonvulsive Action

The correlation between the action of the tested adamantane derivatives 1–8 at the NMDA receptor channel (in vitro) and the anticonvulsive effect (in vivo) has been tested. For this purpose an xy diagram of both test parameters is plotted. It shows that there is a correlation between the blocking of the NMDA receptor channel and the anticonvulsive action of the adamantanes of formula (I).

E. Protection Against Cerebral Ischemia

Both carotid arteries are occluded in rats for 10 minutes. At the same time the blood pressure is reduced to 60–80 mg Hg by withdrawal of blood (Smith et al. 1984, Acta Neurol. Scand. 69: 385, 401). The ischemia is terminated by opening the carotids and reinfusion of the withdrawn blood. After seven days the brains of the test animals are histologically examined for cellular changes in the CA1–CA4 region of the hippocampus, and the percentage of destroyed neurons is determined. The action of test compound No. 1 is determined after a single administration of 5 mg/kg and 20 mg/kg one (1) hour prior to the ischemia.

The results are summarized in the following Table 3:

TABLE 3

Area	Control	Test compound no. 1	
		5 mg/kg (n = 5)	20 mg/kg (n = 6)
CA1	80.2 ± 1.5	83.0 ± 2.2	53.1 ± 6.1**
CA3	3.6 ± 1.1	7.3 ± 1.8	2.7 ± 1.0
CA4	1.4 ± 0.4	3.7 ± 1.7	0.6 ± 0.3

The values are given in percent of damaged neurons ± SEM.
Significance of the mean difference: **p < 0.01 (U test)

The results show that the reduction of the post-ischemic neuronal brain damage in the CA1 region of the rat hippocampus is statistically significant after the pre-ischemic application of 20 mg/kg of test compound no. 1. Physiological parameters (e.g. blood pressure, body temperature) are not affected by the treatment. Moreover, the results show that the compounds according to formula (I) exhibit a neuroprotective action in cerebral ischemia.

Essentially the same result is attained by employing the compounds of the other Examples, especially those designated test compounds 2–8.

F. Protection Against NMDA-Induced Mortality

It is well known that, subsequent to cerebral ischemia, glutamate and aspartate levels increase massively in the brain. These excitatory aminoacids overstimulate

the NMDA-subtype of the glutamate receptor thus leading to delayed neuronal death. A similar pathophysiological situation is obtained when mice are administered intraperitoneally with 200 mg/kg NMDA. This high dose will eventually cause 100% mortality in the animals (Leander et al. 1984, Brain Res. 448; 115–120). We have found that the adamantane derivatives of the present invention are protective against the NMDA-induced mortality.

Compound No.	Dose mg/kg	Protected Animals
1	50	8/8
	25	6/8
	10	3/8
3	50	6/8
	25	4/8
4	50	7/8
	25	5/8
5	25	5/8

In the control animals, to which no adamantane was administered, the mortality was eight (8) animals out of eight (8).

G. Displacement of [^{3}H] MK-801 Binding in Human Brain Tissue

MK-801 binds to the ion channel associated with the NMDA receptor, as well as TCP does. This binding site is thought to mediate the neuroprotective effects of non-competitive NMDA-antagonists.

We have investigated whether the adamantane derivatives of the present invention are active at the MK-801 binding site. Tissue from frontal cortex was taken from patients at autopsy and homogenates were prepared. Inhibition of specific [^{3}H] MK-801 binding (3 nM) by the test compounds was determined (see e.g. Kornhuber et al. 1989, Eur. J. Pharmacol. 166: 589–590).

The test compounds were highly potent in displacing MK-801 binding, thus indicating a specific interaction with the NMDA receptor channel and predicting neuroprotective properties.

Compound No.	Ki nM
1	536
3	598
4	189
5	1607

wherein K_i is the inhibition constant and nM is nanomoles per liter. Mean values from triplicate experiments are given ± S.E.M.

The inhibition constant Ki is approximately equal to the concentration of the adamantane in nM required to displace 50% of the MK-801 specifically bound to the receptor. In this regard, memantine (Compound No. 1) was found to be the most potent compound subjected to this test, when compared with thirteen (13) other clinically-used and centrally-acting drugs, as reported in the foregoing publication.

The invention is further described by the following illustrative examples, which are not to be construed as limiting:

EXAMPLE 1

Injectable Solution

For preparing a 0.5% solution, dissolve 0.5% active ingredient and 0.8% sodium chloride (DAB 9) in doubly distilled water. Filter the solution through an antimicrobial filter, fill into 2-ml ampoules and sterilize for 20 minutes at 120° C. in an autoclave.

EXAMPLE 2

Solution

Dissolve 1% of active agent in demineralized water. Filter the solution before filling.

EXAMPLE 3

Tablets

1 tablet contains:	
Active ingredient	10.0 mg
Lactose	67.5 mg
Microcrystalline cellulose	18.0 mg
Talc	4.5 mg
	100.0 mg

The substances are mixed and the mixture compressed into 100-mg tablets in a direct tableting procedure without granulation.

EXAMPLE 4

Coated Tablets

Prepare 6-mm tablet cores of 100 mg as described under "Tablets". Coat the tablets in a sugar-coating process by coating the core with a sugar suspension first, followed by staining with a colored syrup and polishing.

The tablet coating consists of:

Sugar	65.0 mg
Talc	39.0 mg
Calcium carbonate	13.0 mg
Gum arabic	6.5 mg
Corn starch	3.7 mg
Shellac	1.1 mg
Polyethylene glycol 6000	0.2 mg
Magnesia usta	1.3 mg
Dye	0.2 mg
	130.0 mg

Total tablet weight: 230 mg

EXAMPLE 5

For preparing a 0.01% infusion solution, dissolve 0.01% of active ingredient and 5% levulose in doubly-distilled water. Filter the solution through an antimicrobial filter, fill into 500-ml infusion bottles, and sterilize.

The example provides 50 mg of active substance per single dose.

EXAMPLE 6

Synthesis of 1-Amino-3-isopropyl Adamantane Hydrochloride (Test Compound No. 3)

A. Preparation of Adamantane Methyl Carboxylate (I)

Stir 1.0 mol of adamantane carboxylic acid in 600 ml of methanol. Under ice cooling, drop 1.53 mol of acetyl chloride into the solution within 1 h. Remove the ice bath, and allow the reaction mixture to reach room temperature. Subsequently, heat for 3 hrs under reflux. Evaporate the reaction mixture to dryness under vacuum and distill. (Yield: 97%).

B. Preparation of Isopropyl Adamantane (II)

Introduce 0.5 mol of magnesium chips into 50 ml of absolute ether, and drop 0.5 mol of methyl iodide into the solution under moisture-free conditions until the ether boils. Subsequently, heat in a water bath until the magnesium has completely dissolved. Into this solution at room temperature drop 0.2 mol of adamantane methyl carboxylate in absolute ether. Then heat to reflux for 3 hours. After cooling, hydrolize with ice and mix with ammonium chloride solution until the precipitate has dissolved. Separate the ether phase, wash the aqueous phase with 2 portions of ether, and wash the combined organic phases with sodium bicarbonate solution. Then dry and evaporate to dryness under vacuum. (Yield: 93%).

C. Preparation of Isopropene Adamantane (III)

Stir 0.25 mol of isopropyl adamantane (II) in 500 ml acetic anhydride for 12 hours at 160° C. Subsequently, pour the reaction mixture onto 1 liter of ice water and extract with ether. Dry the combined organic phases with magnesium sulfate, filter, and evaporate to dryness under vacuum. Distill the residue under vacuum. (Yield: 66%).

D. Preparation of Isopropyl Adamantane (IV)

Dissolve 0.074 mol of adamantyl isopropene (III) in 100 ml of absolute ethanol. Add 4 g of palladium (5% on activated carbon) and hydrate under stirring for 24 hrs at room temperature. Subsequently, filter off the catalyst, and remove the solvent under vacuum. (Yield: 91%).

E. Preparation of 1-Bromo-3-isopropyl Adamantane (V)

Mix 0.034 mol of isopropyl adamantane (IV) with a ten times excess of bromine (0.33 mol). Heat slowly and stir under reflux for 4 h. Subsequently, allow to cool and pour onto ice water. Decompose the excess bromine with sodium sulfite until the aqueous solution has discolored. Then extract with ether, wash the combined organic phases with sodium bicarbonate solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 83%).

F. Preparation of 1-N-formyl-3-isopropyl Adamantane (VI)

Heat 0.028 mol of 1-bromo-3-isopropyl adamantane (V) with 40 ml of formamide to reflux for 12 hrs. After cooling, pour the reaction mixture onto water and extract with dichloromethane. Dry the combined organic phases with magnesium sulfate, filter and evaporate to dryness under vacuum. (Yield: 82%).

G. Preparation of 1-Amino-3-isopropyl Adamantane Hydrochloride

Mix 0.023 mol of 1-N-formyl-3-isopropyl adamantane (VI) with 100 ml of 15% hydrochloric acid and heat to boiling for 24 hrs. After cooling, filter the precipitate and recrystallize from isopropanol. (Yield: 57%).

EXAMPLE 7

Synthesis of 1-Amino-3-cyclohexyl Adamantane Hydrochloride (Test Compound No. 7)

A. Preparation of 1-Phenyl Adamantane (I)

Heat 0.068 mol of iron(III) chloride to boiling in 20 ml of absolute benzene. Drop 0.0186 mol of 1-bromoadamantane, dissolved in 30 ml of absolute benzene, to the solution. Then heat to boiling for 3 hrs. After cooling, pour the reaction mixture onto ice/hydrochloric acid, separate the organic phase, and extract the aqueous phase with two portions of benzene. Wash the combined organic phases with water, dry with calcium chloride, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 80%).

B. Preparation of 1-Hydroxy-3-phenyl Adamantane (II)

To a solution of 0.03 mol chromiumtrioxide in 20 ml glacial acetic acid and 20 ml acetic anhydride, add 0.0095 mol of 1-phenyl adamantane at 0° C. and stir for 24 hours at 4° C. Pour the reaction mixture onto water and extract with three portions of pentane. Wash the organic phase with saturated sodium chloride solution, dry over magnesium sulfate, filter and evaporate to dryness under vacuum. Hydrolize the residue with 20 ml of 2N NaOH and 50 ml of methanol. Subsequently, remove the methanol under vacuum and dilute the residue with water. Then extract with three portions of ether. Dry the organic phase, filter and evaporate to dryness under vacuum. Recrystallize the residue from cyclohexane. (Yield: 50%).

Ref.: H. Stetter, M. Schwarz, A. Hirschhorn, Chem. Ber. (1959), 92, 1629–35.

C. Preparation of 1-Bromo-3-phenyl Adamantane (III)

Stir 0.03 mol of 3-phenyl adamantanol (II) with 100 ml of 40% HBr in glacial acetic acid for 20 min at 60° C. and 30 min at room temperature. Subsequently, dilute the reaction mixture with water and extract with ether. Wash the combined organic extracts with sodium chloride solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 68%).

Ref.: W. Fischer, C. A. Grog, Helvetica Chim. Acta (1976), 59, 1953.

D. Preparation of 1-N-formyl-3-phenyl Adamantane (IV)

Heat 0.03 mol of 1-bromo-3-phenyl adamantane (III) with 50 ml of formamide for 12 hrs to reflux. After cooling, pour the reaction mixture onto water and extract with dichloromethane. Dry the combined organic phases with magnesium sulfate, filter and evaporate to dryness under vacuum. (Yield: 80%).

E. Preparation of 1-Amino-3-phenyl Adamantane Hydrochloride (V)

Heat 0.02 mol of 1-N-formyl-3-phenyl adamantane (IV) with 100 ml of 15% hydrochloric acid at reflux for 24 hours. After cooling, filter the precipitate and recrystallize from isopropanol. (Yield: 60%).

F. Preparation of 1-Amino-3-cyclohexyl Adamantane (VI)

Dissolve 0.011 mol of 1-amino-3-phenyl adamantane (V) in 150 ml glacial acetic acid, mix with 0.3 g of platinum oxide (1% on activated carbon) and hydrate in a

Parr apparatus at 35° C. at a hydrogen pressure of 3 bar. Subsequently, remove the catalyst by filtration and evaporate the filtrate to dryness. Take up the residue in methanol and precipitate the product with ether. Suck off and dry. (Yield: 70%).

EXAMPLE 8

Synthesis of 1-Amino-3,5-dimethyl-7-ethyl Adamantane Hydrochloride (Test Compound No. 8)

A. Preparation of 1-Bromo-3,5-dimethyl Adamantane (I)

Mix 0.5 mol of 1,3-dimethyl adamantane with a ten times excess of bromine (5 mol). Slowly heat and stir for 4 hrs under reflux. Subsequently, allow to cool and pour onto ice water. Decompose the excess bromine with sodium sulfite until discoloration of the aqueous solution. Then extract with ether, wash the combined organic phases with sodium bicarbonate solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 83%).

B. Preparation of 1-(2-Bromoethyl)-3,5-dimethyl Adamantane (II)

Mix 1.4 mol of 1-bromo-3,5-dimethyl adamantane (I) in hexane with 0.6 mol of aluminum bromide at −75° C. Subsequently, pass ethylene through the solution for 20–30 minutes, stir for 5 min., and pour the reaction mixture onto ice water. Extract with ether, dry the organic phase and evaporate to dryness. Recrystallize the residue from methanol. (Yield: 48%).

C. Preparation of 1,3-Dimethyl-5-ethyl Adamantane (III)

Dissolve 0.5 mol of 1-(2-bromoethyl)-3,5-dimethyl adamantane (II) in toluene, mix with 0.55 mol of sodium-bis(2-methoxy-ethoxy)dihydro aluminate, and heat to boiling for 3 hrs. After hydrolysis, separate the organic phase, dry with magnesium sulfate, and evaporate to dryness under vacuum. Purify the residue by vacuum distillation. (Yield: 86%).

D. Preparation of 1-Bromo-3,5-dimethyl-7-ethyl Adamantane (IV)

Mix 0.4 mol of 1,3-dimethyl-5-ethyl adamantane (III) with a ten times excess of bromine (4 mol). Heat slowly and stir for 4 hrs under reflux. Subsequently allow to cool and pour onto ice water. Decompose the excess bromine with sodium sulfite until discolouration of the aqueous solution. Then extract with ether, wash the combined organic phases with sodium bicarbonate solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 86%).

E. Preparation of 1-N-formyl-3,5-dimethyl-7-ethyl Adamantane (V)

Heat 0.2 mol of 1-bromine-3,5-dimethyl-7-ethyl adamantane (IV) with 150 ml of formamide at reflux for 12 hrs. After cooling, pour the reaction mixture onto water and extract with dichloromethane. Dry the combined organic phases with magnesium sulfate, filter and evaporate to dryness under vacuum. (Yield: 82%).

F. Preparation of 1-Amino-3,5-dimethyl-7-ethyl Adamantane Hydrochloride (VI)

Mix 0.2 mol of 1-N-formyl-3,5-dimethyl-7-ethyl adamantane (V) with 100 ml of 15% hydrochloric acid and heat to boiling for 24 hrs. After cooling, filter the precipitate and recrystallize from isopropanol. (Yield: 57%).

EXAMPLE 9

Synthesis of 1-N-methylamino-3,5-dimethyl Adamantane (Test Compound No. 5)

Dissolve 0.1 mol of the appropriately substituted amino adamantane (1-amino-3,5-dimethyl adamantane) with 0.15 mol of chloromethyl formate and potassium carbonate in acetone and heat to reflux for 8 hrs. After cooling, filter the solution, remove the solvent and dry the residue. Mix the raw product (0.05 mol) with 0.1 mol of sodium-bis-(2-methoxy-ethoxy)-dihydro aluminate in toluene and heat at reflux for 3 hrs. After cooling, hydrolize with dilute HCl, dry the organic phase and evaporate to dryness. Purify the raw material by distillation.

EXAMPLE 10

Synthesis of 1-Amino-3-ethyl-5-phenyl Adamantane

A. Preparation of 1-Bromo-3-ethyl Adamantane (I)

Mix 0.034 mol of ethyl adamantane with a ten times excess of bromine (0.33 mol). Heat slowly and stir under reflux for 4 hrs. Then allow to cool and pour onto ice water. Decompose the excess bromine with sodium sulfite until discoloration of the aqueous solution. Subsequently extract with ether, wash the combined organic phases with sodium bicarbonate solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 83%).

B. Preparation of 1-Ethyl-3-phenyl Adamantane (II)

Heat 0.068 mol of iron(III) chloride in 20 ml of absolute benzene to boiling. Drop 0.0186 mol of 1-bromo-3-ethyl adamantane (I), dissolved in 30 ml of absolute benzene, into the solution. Then heat at reflux for 3 hrs. After cooling, pour the reaction mixture onto ice/hydrochloric acid, separate the organic phase, and extract with two portions of benzene. Wash the combined organic phases with water, dry with calcium chloride, filter and evaporate to dryness. Recrystallize the residue from methanol. (Yield: 80%).

C. Preparation of 1-Ethyl-3-hydroxy-5-phenyl Adamantane (III)

To a solution of 0.03 mol of chromiumtrioxide, in 20 ml glacial acetic acid and 20 ml acetic anhydride, add 0.0095 mol of 1-ethyl-3-phenyl adamantane (II) at 0° C. and stir for 24 hours at 4° C. Pour the reaction mixture into water and extract with three portions of pentane. Wash the organic phase with saturated sodium chloride solution, dry over magnesium sulfate, filter and evaporate to dryness under vacuum. Hydrolize the residue with 20 ml of 2N NaOH and 50 ml of methanol. Remove the methanol under vacuum and dilute the residue with water. Then extract with three portions of ether. Dry the organic phase, filter and evaporate to dryness under vacuum. Recrystallize the residue from cyclohexane. (Yield: 50%).

Ref.: H. Stetter, M. Schwarz, A. Hirschhorn, Chem. Ber. (1959), 92, 1629–35.

D. Preparation of 1-Bromo-3-ethyl-5-phenyl Adamantane (IV)

Stir 0.03 mol of 1-ethyl-3-hydroxy-5-phenyl adamantane (III) with 100 ml of 40% HBr in glacial acetic acid for 20 min at 60° C. and for 30 min at room temperature. Subsequently dilute the reaction mixture with water and extract with ether. Wash the combined organic extracts with sodium chloride solution, dry with magnesium sulfate, filter and evaporate to dryness under vacuum. Recrystallize the residue from methanol. (Yield: 68%).

Ref.: W. Fischer, C. A. Grog, Helvetica Chim. Acta (1976), 59, 1953.

E. Preparation of 1-N-formyl-3-ethyl-5-phenyl Adamantane (V)

Heat 0.03 mol of 1-ethyl-3-hydroxy-5-phenyl adamantane (IV) with 50 ml of formamide for 12 hrs at reflux. After cooling, pour the reaction mixture into water and extract with dichloromethane. Dry the combined organic phases with magnesium sulfate, filter and evaporate to dryness. (Yield: 80%).

F. Preparation of 1-Amino-3-ethyl-5-phenyl Adamantane Hydrochloride (VI)

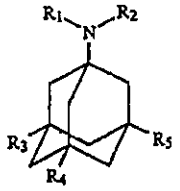
Heat 0.02 mol of 1-N-formyl-3-ethyl-5-phenyl adamantane (V) with 100 ml of 15% hydrochloric acid for 24 hrs at reflux. After cooling, filter the precipitate and recrystallize from isopropanol. (Yield: 60%).

It is thus seen that certain adamantane derivatives, some of which are novel, have been provided for the prevention and treatment of cerebral ischemia, and that pharmaceutical compositions embodying such an adamantane derivative have been provided for use in the prevention and treatment of cerebral ischemia, the amount of the said adamantane derivative provided in either case being a cerebral ischemia-alleviating or preventive amount.

Various modifications and equivalents will be apparent to one skilled in the art and may be made in the compounds, compositions, methods, and procedures of the present invention without departing from the spirit or scope thereof, and it is therefore to be understood that the invention is to be limited only by the full scope which can be legally attributed to the appended claims.

We claim:

1. A method for the prevention or treatment of cerebral ischemia comprising the step of administering, to a patient in need thereof, an effective amount of an adamantane derivative of the general formula



(I)

wherein

R_1 and R_2 are identical or different and represent hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group,

or a pharmaceutically-acceptable salt thereof.

2. A method according to claim 1, wherein R_1, R_2 and R_5 are hydrogen.

3. A method according to claim 2, wherein R_1, R_2 and R_5 are hydrogen, and R_3 and R_4 are methyl.

4. A method according to claim 2, wherein R_1, R_2 and R_5 are hydrogen, and R_3 and R_4 are ethyl.

5. A method according to claim 1, wherein R_1, R_2, R_4 and R_5 are hydrogen, and R_3 is ethyl, isopropyl, or cyclohexyl.

6. A method according to claim 1, wherein R_2 and R_5 are hydrogen.

7. A method according to claim 6, wherein R_3 and R_4 are methyl, R_2 and R_5 are hydrogen and R_1 is methyl or ethyl.

8. A method according to claim 1, wherein R_1 and R_2 are hydrogen.

9. A method according to claim 8, wherein R_1 and R_2 are hydrogen, R_3 is ethyl, and R_5 and R_4 are methyl.

10. A method according to claim 1 for the treatment of Alzheimer's disease.

11. A method of claim 1, wherein the adamantane derivative is administered in an effective cerebral ischemia-alleviating or preventive amount.

12. A method of claim 11, wherein the adamantane derivative is administered in the form of a composition containing the same together with a pharmaceutically-acceptable carrier or diluent.

13. A method of claim 11, wherein the adamantane derivative is administered in an amount effective to prevent degeneration and loss of nerve cells after ischemia.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,061,703 C1
APPLICATION NO. : 90/007176
DATED : November 7, 2006
INVENTOR(S) : Joachim Bormann et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 1, line 56: delete "wherein" and substitute --*wherein*--.

Claim 1, line 57: delete "R_4 *and*" and substitute --R_4, *and*--.

Claim 1, line 58: delete "*simultaneously;*" and substitute --*simultaneously,*--.

Claim 10, line 62: delete "disease *wherein*" and substitute --disease, *wherein*--.

Claim 18, line 64: delete "in" and substitute --is--.

Signed and Sealed this

Fifth Day of June, 2007

JON W. DUDAS
Director of the United States Patent and Trademark Office

EXHIBIT B

US005061703C1

(12) EX PARTE REEXAMINATION CERTIFICATE (5595th)

United States Patent
Bormann et al.

(10) Number: US 5,061,703 C1
(45) Certificate Issued: Nov. 7, 2006

(54) ADAMANTANE DERIVATIVES IN THE PREVENTION AND TREATMENT OF CEREBRAL ISCHEMIA

(75) Inventors: Joachim Bormann, Frankfurt (DE); Markus R. Gold, Nauheim (DE); Wolfgang Schatton, Eschborn (DE)

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(52) U.S. Cl. 514/212.01; 514/325; 514/359
(58) Field of Classification Search 514/212.01, 514/325, 359
See application file for complete search history.

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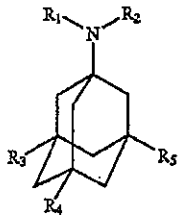
(Continued)

Primary Examiner—Kevin E. Weddington

(57) ABSTRACT

A method for the prevention and treatment of cerebral ischemia using an adamantane derivative of the formula

(I)



wherein

R_1 and R_2 are identical or different, representing hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

R_5 is hydrogen or a straight or branched C_1-C_6 alkyl group,

or a pharmaceutically-acceptable salt thereof, is disclosed.

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Marcea et al. Therapiewoche, 38:3097–3100 (1988).
Fleischhacker et al., Progress in Neuro–Psychopharmacology & Biological Psychiatry, 10:87–93 (1986).
Ambrozi et al., Pharmacopsychiatry, 21:144–146 (1988).

EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

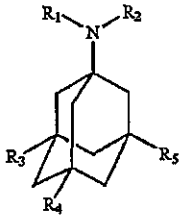
AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims 1 and 10 are determined to be patentable as amended.

Claims 2–9 and 11–13, dependent on an amended claim, are determined to be patentable.

New claims 14–19 are added and determined to be patentable.

1. A method for the prevention or treatment of cerebral ischemia comprising the step of *orally* administering, to a patient *diagnosed with Alzheimer's disease and* in need thereof, an effective amount of an adamantane derivative of the general formula



wherein

R_1 and R_2 are identical or different and represent hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group; *and*

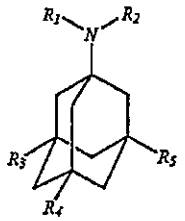
wherein

R_1, R_2, R_3, R_4 and R_5 do not all represent hydrogen simultaneously;

or a pharmaceutically-acceptable salt thereof.

10. A method according to claim 1 for the treatment of Alzheimer's disease *wherein said adamantane derivative is memantine and said effective amount is from about 0.01 to 100 mg/kg.*

14. A method for the treatment of cerebral ischemia comprising orally administering to a patient diagnosed with Alzheimer's disease and in need of such treatment an effective amount of an adamantane derivative of the general formula



wherein

R_1 and R_2 are identical or different and represent hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group; and

wherein

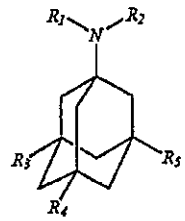
R_1, R_2, R_3, R_4, and R_5 do not all represent hydrogen simultaneously,

or a pharmaceutically-acceptable salt thereof.

15. The method of claim 14, wherein said adamantane derivative is memantine.

16. The method of claim 14, wherein said effective amount is from about 0.01 to 100 mg/kg.

17. A method for the treatment of an imbalance of neuronal stimulation after Alzheimer's disease, comprising orally administering to a patient diagnosed with Alzheimer's disease and in need of such treatment an effective amount of an adamantane derivative of the general formula



wherein

R_1 and R_2 are identical or different and represent hydrogen or a straight or branched alkyl group of 1 to 6 C atoms or, in conjunction with N, a heterocyclic group with 5 or 6 ring C atoms;

wherein

R_3 and R_4 are identical or different, being selected from hydrogen, a straight or branched alkyl group of 1 to 6 C atoms, a cycloalkyl group with 5 or 6 C atoms, and phenyl;

wherein

R_5 is hydrogen or a straight or branched C_1–C_6 alkyl group; and

wherein

R_1, R_2, R_3, R_4, and R_5 do not all represent hydrogen simultaneously,

or a pharmaceutically-acceptable salt thereof.

18. The method of claim 17, wherein said adamantane derivative in memantine.

19. The method of claim 17, wherein said effective amount is from about 0.01 to 100 mg/kg.

* * * * *

JS 44 (Rev. 11/04)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFFS
Forest Laboratories, Inc., Forest Laboratories Holdings, Ltd., Merz Pharma GmbH & Co. KGaA and Merz Pharmaceuticals GmbH

(b) County of Residence of First Listed Plaintiff _____
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorney's (Firm Name, Address, and Telephone Number)
Maryellen Noreika, MORRIS, NICHOLS, ARSHT & TUNNELL LLP, 1201 North Market Street, P.O. Box 1347, Wilmington, DE 19899-1347, (302) 658-9200

DEFENDANTS
Orgenus Pharma Inc.

County of Residence of First Listed Defendant _____
(IN U.S. PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED.

Attorneys (If Known)

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant)
(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated *or* Principal Place of Business In This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated *and* Principal Place of Business In Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT
- ☐ 110 Insurance
- ☐ 120 Marine
- ☐ 130 Miller Act
- ☐ 140 Negotiable Instrument
- ☐ 150 Recovery of Overpayment & Enforcement of Judgment
- ☐ 151 Medicare Act
- ☐ 152 Recovery of Defaulted Student Loans (Excl. Veterans)
- ☐ 153 Recovery of Overpayment of Veteran's Benefits
- ☐ 160 Stockholders' Suits
- ☐ 190 Other Contract
- ☐ 195 Contract Product Liability
- ☐ 196 Franchise

REAL PROPERTY
- ☐ 210 Land Condemnation
- ☐ 220 Foreclosure
- ☐ 230 Rent Lease & Ejectment
- ☐ 240 Torts to Land
- ☐ 245 Tort Product Liability
- ☐ 290 All Other Real Property

TORTS

PERSONAL INJURY
- ☐ 310 Airplane
- ☐ 315 Airplane Product Liability
- ☐ 320 Assault, Libel & Slander
- ☐ 330 Federal Employers' Liability
- ☐ 340 Marine
- ☐ 345 Marine Product Liability
- ☐ 350 Motor Vehicle
- ☐ 355 Motor Vehicle Product Liability
- ☐ 360 Other Personal Injury

PERSONAL INJURY
- ☐ 362 Personal Injury - Med. Malpractice
- ☐ 365 Personal Injury - Product Liability
- ☐ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ☐ 370 Other Fraud
- ☐ 371 Truth in Lending
- ☐ 380 Other Personal Property Damage
- ☐ 385 Property Damage Product Liability

CIVIL RIGHTS
- ☐ 441 Voting
- ☐ 442 Employment
- ☐ 443 Housing/ Accommodations
- ☐ 444 Welfare
- ☐ 445 Amer. w/Disabilities - Employment
- ☐ 446 Amer. w/Disabilities - Other
- ☐ 440 Other Civil Rights

PRISONER PETITIONS
- ☐ 510 Motions to Vacate Sentence

Habeas Corpus:
- ☐ 530 General
- ☐ 535 Death Penalty
- ☐ 540 Mandamus & Other
- ☐ 550 Civil Rights
- ☐ 555 Prison Condition

FORFEITURE/PENALTY
- ☐ 610 Agriculture
- ☐ 620 Other Food & Drug
- ☐ 625 Drug Related Seizure of Property 21 USC 881
- ☐ 630 Liquor Laws
- ☐ 640 R.R. & Truck
- ☐ 650 Airline Regs.
- ☐ 660 Occupational Safety/Health
- ☐ 690 Other

LABOR
- ☐ 710 Fair Labor Standards Act
- ☐ 720 Labor/Mgmt. Relations
- ☐ 730 Labor/Mgmt.Reporting & Disclosure Act
- ☐ 740 Railway Labor Act
- ☐ 790 Other Labor Litigation
- ☐ 791 Empl. Ret. Inc. Security Act

BANKRUPTCY
- ☐ 422 Appeal 28 USC 158
- ☐ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- ☐ 820 Copyrights
- ☒ 830 Patent
- ☐ 840 Trademark

SOCIAL SECURITY
- ☐ 861 HIA (1395ff)
- ☐ 862 Black Lung (923)
- ☐ 863 DIWC/DIWW (405(g))
- ☐ 864 SSID Title XVI
- ☐ 865 RSI (405(g))

FEDERAL TAX SUITS
- ☐ 870 Taxes (U.S. Plaintiff or Defendant)
- ☐ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
- ☐ 400 State Reapportionment
- ☐ 410 Antitrust
- ☐ 430 Banks and Banking
- ☐ 450 Commerce
- ☐ 460 Deportation
- ☐ 470 Racketeer Influenced and Corrupt Organizations
- ☐ 480 Consumer Credit
- ☐ 490 Cable/Sat TV
- ☐ 810 Selective Service
- ☐ 850 Securities/Commodities/ Exchange
- ☐ 875 Customer Challenge 12 USC 3410
- ☐ 890 Other Statutory Actions
- ☐ 891 Agricultural Acts
- ☐ 892 Economic Stabilization Act
- ☐ 893 Environmental Matters
- ☐ 894 Energy Allocation Act
- ☐ 895 Freedom of Information Act
- ☐ 900Appeal of Fee Determination Under Equal Access to Justice
- ☐ 950 Constitutionality of State Statutes

V. ORIGIN (Place an "X" in One Box Only)
☒ 1 Original Proceeding ☐ 2 Removed from State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION
Cite the U.S. Civil Statute under which you are filing (Do not cite jurisdictional statutes unless diversity):
35 U.S.C. § 271
Brief description of cause:
patent infringement

VII. REQUESTED IN COMPLAINT:
☐ CHECK IF THIS IS A CLASS ACTION UNDER F.R.C.P. 23
DEMAND $
CHECK YES only if demanded in complaint:
JURY DEMAND: ☐ Yes ☒ No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE Sleet DOCKET NUMBER 08-21 08-22 08-52

DATE May 16, 2008
SIGNATURE OF ATTORNEY OF RECORD Maryellen Noreika

FOR OFFICE USE ONLY

RECEIPT # _____ AMOUNT _____ APPLYING IFP _____ JUDGE _____ MAG. JUDGE _____

INSTRUCTIONS FOR ATTORNEYS COMPLETING CIVIL COVER SHEET FORM JS 44

Authority For Civil Cover Sheet

The JS 44 civil cover sheet and the information contained herein neither replaces nor supplements the filings and service of pleading or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. Consequently, a civil cover sheet is submitted to the Clerk of Court for each civil complaint filed. The attorney filing a case should complete the form as follows:

I. (a) Plaintiffs-Defendants. Enter names (last, first, middle initial) of plaintiff and defendant. If the plaintiff or defendant is a government agency, use only the full name or standard abbreviations. If the plaintiff or defendant is an official within a government agency, identify first the agency and then the official, giving both name and title.

(b) County of Residence. For each civil case filed, except U.S. plaintiff cases, enter the name of the county where the first listed plaintiff resides at the time of filing. In U.S. plaintiff cases, enter the name of the county in which the first listed defendant resides at the time of filing. (NOTE: In land condemnation cases, the county of residence of the "defendant" is the location of the tract of land involved.)

(c) Attorneys. Enter the firm name, address, telephone number, and attorney of record. If there are several attorneys, list them on an attachment, noting in this section "(see attachment)".

II. Jurisdiction. The basis of jurisdiction is set forth under Rule 8(a), F.R.C.P., which requires that jurisdictions be shown in pleadings. Place an "X" in one of the boxes. If there is more than one basis of jurisdiction, precedence is given in the order shown below.

United States plaintiff. (1) Jurisdiction based on 28 U.S.C. 1345 and 1348. Suits by agencies and officers of the United States are included here.

United States defendant. (2) When the plaintiff is suing the United States, its officers or agencies, place an "X" in this box.

Federal question. (3) This refers to suits under 28 U.S.C. 1331, where jurisdiction arises under the Constitution of the United States, an amendment to the Constitution, an act of Congress or a treaty of the United States. In cases where the U.S. is a party, the U.S. plaintiff or defendant code takes precedence, and box 1 or 2 should be marked.

Diversity of citizenship. (4) This refers to suits under 28 U.S.C. 1332, where parties are citizens of different states. When Box 4 is checked, the citizenship of the different parties must be checked. (See Section III below; federal question actions take precedence over diversity cases.)

III. Residence (citizenship) of Principal Parties. This section of the JS 44 is to be completed if diversity of citizenship was indicated above. Mark this section for each principal party.

IV. Nature of Suit. Place an "X" in the appropriate box. If the nature of suit cannot be determined, be sure the cause of action, in Section VI below, is sufficient to enable the deputy clerk or the statistical clerks in the Administrative Office to determine the nature of suit. If the cause fits more than one nature of suit, select the most definitive.

V. Origin. Place an "X" in one of the seven boxes.

Original Proceedings. (1) Cases which originate in the United States district courts.

Removed from State Court. (2) Proceedings initiated in state courts may be removed to the district courts under Title 28 U.S.C., Section 1441. When the petition for removal is granted, check this box.

Remanded from Appellate Court. (3) Check this box for cases remanded to the district court for further action. Use the date of remand as the filing date.

Reinstated or Reopened. (4) Check this box for cases reinstated or reopened in the district court. Use the reopening date as the filing date.

Transferred from Another District. (5) For cases transferred under Title 28 U.S.C. Section 1404(a). Do not use this for within district transfers or multidistrict litigation transfers.

Multidistrict Litigation. (6) Check this box when a multidistrict case is transferred into the district under authority of Title 28 U.S.C. Section 1407. When this box is checked, do not check (5) above.

Appeal to District Judge from Magistrate Judgment. (7) Check this box for an appeal from a magistrate judge's decision.

VI. Cause of Action. Report the civil statute directly related to the cause of action and give a brief description of the cause. **Do not cite jurisdictional statutes unless diversity.** Example: U.S. Civil Statute: 47 USC 553
Brief Description: Unauthorized reception of cable service

VII. Requested in Complaint. Class Action. Place an "X" in this box if you are filing a class action under Rule 23, F.R.Cv.P.

Demand. In this space enter the dollar amount (in thousands of dollars) being demanded or indicate other demand such as a preliminary injunction.

Jury Demand. Check the appropriate box to indicate whether or not a jury is being demanded.

VIII. Related Cases. This section of the JS 44 is used to reference related pending cases if any. If there are related pending cases, insert the docket numbers and the corresponding judge names for such cases.

Date and Attorney Signature. Date and sign the civil cover sheet.